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To: Agriculture Water Use Efficiency
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Subject: BUFA

As the agronomic beneficial use equation (BUF_A) is presently set up, “best professional estimates” of additional quantities of water used for agronomic ends such as leaching, temperature control and frost protection are added to ETAW, and this sum is divided by applied water to calculate the agronomic beneficial use fraction (BUF_A). The result of this procedure is to imply, if not to demonstrate, that efficiencies are increased by adding water from the least quantifiable categories of agricultural water use.

The manner in which the professionally estimated quantities are incorporated into the calculation of BUF_A is problematic. Addition of a best professional estimate of agronomic use water, however arrived at, to the numerator of the BUF_A fraction as an unmodified quantity fails to recognize that agronomic uses have associated efficiencies. Adding quantities in this way serves only to increase the magnitude of the numerator, and thereby to increase BUF_A efficiency above that of the consumptive use fraction (CUF). Even if efficiency is accounted for in arriving at a best professional estimate, addition of the estimate to the numerator can only increase BUF_A efficiency. Calculating the efficiencies of each of the agronomic uses, and then arriving at BUF_A by calculating an average of the several efficiencies and the CUF, weighted by the water used in each category, recognizes the efficiencies associated with agronomic uses.

Leaching is often an inefficient process. Salts accumulated over a season will have migrated into micropores and (this is not an exclusive distinction) into soil aggregates. Most of the water applied for leaching flows through larger pores and preferential flow structures, and, in so doing, bypasses micropores and aggregates. Salts in micropores must diffuse outward along the concentration gradient into the more leached volumes of soil before becoming, in turn, available for leaching. Several studies have demonstrated increased leaching efficiency, measured as salt leached per unit volume of applied water, when leaching is interspersed with intervals of time during which salts redistribute. Studies also have demonstrated increased efficiency obtained by low application rates for extended periods of time. Time is, of course, extended.

The efficiency of frost protection operations might be evaluated by a function incorporating sprinkler system distribution uniformity, application rate, run time and minimum temperatures, and this efficiency can be compared against the frost protection efficiencies of furrow irrigation, wind machines and helicopters under similar conditions. Neither leaching efficiencies nor frost protection efficiencies are revealed by adding a quantity of water to the numerator of the BUF_A calculation.

The examples above are provided to illustrate what I believe to be the misleading effect of incorporating additional volumes of water that do not all have equal justification into the numerator of the BUF_A calculation. These efficiencies are impractical to assess on a routine basis, but clarity requires some method to account for these uses.

The more straightforward method is simply not to distinguish agronomic uses from applied water. This is justifiable on the basis that agronomic uses are as necessary as ET to cultivate a crop. If it is felt there is something useful to be captured by considering agronomic uses as a separable category, the CUF should be calculated with best professionally estimated agronomic use amounts of water adjusted for efficiency subtracted from the denominator and explained

separately. Subtracting agronomic water from the denominator will help maintain the integrity of the CUF. BUF_A would become a separate quantity consisting only of agronomic use water with its own estimated efficiency. The CUF will remain the result only of water used for ET, on-farm transmission losses, irrigation system uniformity, irrigation management, spatial variabilities of soil hydraulic properties and of denitrifying bacteria, the genetic fitness of the cultivar for the site, and the weather.

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